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16. ABSTRACT

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Recreation Benefits and Displaced Facilities[1]

Ronald J. Sutherland

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KEYWORDS: *Recreation benefits, displaced facilities.*

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I. Introduction

The proper measure of the monetary value of a recreational site has long been of interest to academic researchers and to recreation planners in state and Federal agencies. The economic concept of net willingness to pay (or consumer surplus) is now widely accepted as the appropriate measure of benefits. However, a complexity arises when the net willingness to pay for a new or improved site comes at the expense of an existing substitute site. If measured benefits of the new site contain a large

[1]The research for this paper was conducted while the author was with the Environmental Protection Agency, Corvallis Environmental Research Laboratory. The constructive comments from Neils Christiansen and A. Myrick Freeman are greatly appreciated.

component of benefits that have been redistributed from other sites, then these estimated benefits overstate true social benefits.

The issue of how to treat benefits that are redistributed from displaced facilities can only be resolved through economic analysis. The resolution, though, is of obvious practical importance. If benefits can be measured correctly by estimating net willingness to pay for the new or improved site and by excluding benefits foregone, then estimating recreational site benefits is feasible. If, however, foregone benefits must be subtracted explicitly from the benefits of a new site, then all relevant substitutes must be identified and their demand curves estimated. Such a task is empirically infeasible. The importance of being able to value recreational sites, or more appropriately, the recreational use of the site, requires that we have a concise definition of these benefits.

In Sec. II, I review some recreation literature and show that some researchers are not sure how to treat displaced benefits. Other researchers have constructed elaborate econometric models that explicitly subtract benefits redistributed from substitute sites. The most commonly held view is that benefits can be measured correctly by estimating willingness to pay at the new or improved site and ignoring shifts in the demand for substitutes. A main objective in reviewing these studies is to show the absence of the necessary justification for this position. Indeed, researchers who argue that benefits from displaced facilities can be ignored often derive their support by quoting each other.

One objective of this paper is to determine the proper measure of benefits of a new or improved recreational site when demand for this site comes at the expense of existing sites. In Sec. III, I show that benefits are measured correctly as net willingness to pay for the new or improved site and that any displaced benefits can be ignored. My main objective, though, is to provide theoretical support for this view. In Sec. III, I show that the appropriate measure of benefits can be derived from an elementary exercise in demand theory. The analysis requires the assumption that the prices of other goods (that is, substitute sites) remain constant. In Sec. IV, I assume that a new recreational site affects the price of other goods. The proper measure of recreational benefits now must account for the change in benefits in those markets where prices have changed. This case is clearly the exception because the price of a recreational site is either zero or fixed, and is, therefore, insensitive to changes in other prices.

II. Overview of Benefits in the Recreation Literature

This brief overview of benefits measurement in the recreation literature focuses on two questions: (1) What is the appropriate measure of benefits of a new or improved site when demand for that site comes at the expense of substitute sites? and (2) What is the explicit theoretical justification for the commonly accepted definition of benefits?

All recreation benefit analyses contain some definition of benefits,

but the issue of measuring benefits when there exist close subsitutes has only recently been considered. For instance, in the exchange by Stevens (1966, 1967) and Burt (1969) on the fishing benefits of water pollution control, no consideration was given to demand shifts for fishing at substitute sites. Reiling, Gibbs, and Stoevener (1973:3) avoid this issue by explicitly assuming that expanded use of one site does not come at the expense of substitute sites. I review some of the more recent literature by Knetsch (1977), Mishan (1976), Freeman (1979), and Cesario and Knetsch (1976), which specifically considers measuring benefits at one site when there exist substitute sites. My focus is on how benefits are measured and particularly on how this benefit measure is justified.

A. Knetsch

Knetsch (1977) is concerned with the evaluation of benefits at a proposed site when there is an identical displaced facility requiring a greater travel cost. To review Knetsch's position, the demand curve for an existing site is depicted in Figure 1. Quantity demanded is 1,000 recreation days and consumers' surplus is $2,500. Assume that a second identical site is constructed that reduces travel costs by $1 for each population center. The demand curve for the second (proposed) site appears on the right hand side of Figure 1. The area above $1 and under this demand curve is equal to the area under the demand curve for the existing site. According to Knetsch, the demand curve for the new site begins at

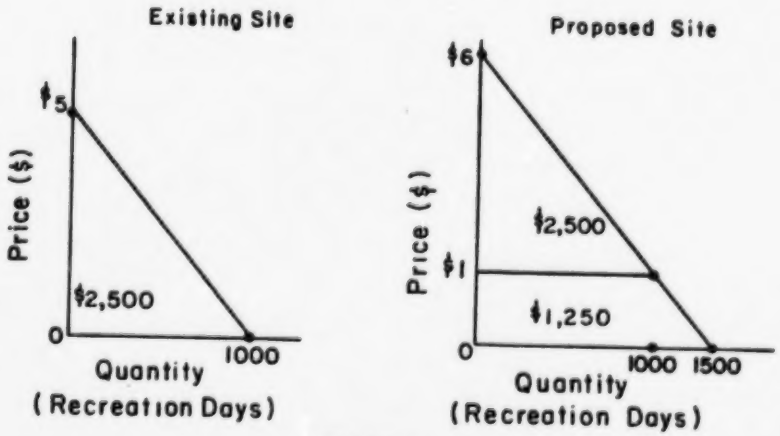

FIGURE 1

RECREATION DEMAND AND BENEFITS: THE KNETSCH ANALYSIS

$Q = 1,500$ but becomes horizontal at \$1, because at a fee of \$1 or more all recreationists return to the initial site. The increase in total benefits is \$1,250, which is the area under the new (kinked) demand curve. Knetsch concludes that the demand curve for the new facility must reflect existing facilities, but the loss in value of the existing facility can and should be ignored in calculating the net gain of the new facility.

In Knetsch's analysis, benefits measured at the new site do not include a redistribution of willingness to pay from a substitute site because no redistribution occurs. The willingness to pay for the first site is \$2,500 before the new site is constructed, and it is \$2,500 after the new site is constructed. As the price of the new site rises above \$1, the willingness to pay for the existing site remains unchanged. Knetsch's analysis is based on a special case in which the demand curve for the substitute site doesn't shift. Because there is no decrease in willingness to pay for the substitute site, his analysis provides no support for the position that the decrease in willingness to pay for substitute sites can be neglected when measuring net benefits of a new or improved site.

However, a particularly important econometric implication of Knetsch's analysis is the need to include some measure of substitutes when estimating the site demand function. If the specification of the proposed site excludes the existing site, the continuous demand curve from $Q = 1,500$ to $P = \$6$ would be estimated. Benefits would be estimated as the area under this curve and would thereby be overestimated by \$2,500. By correctly specifying the demand for the proposed site, the kinked demand curve would presumably be estimated. Benefits of the proposed site would be correctly estimated at \$1,250.

B. Mishan

In his authoritative treatise on cost-benefit analysis, Mishan (1976) addresses the issue of measuring consumers' surplus when increased purchases of one good are at the expense of other goods. Mishan states that if a new good is introduced or the price of a good falls, consumers' surplus should be measured by neglecting changes in consumers' surplus of alternative goods. He says:

> . . . I append a note to this chapter containing a simple example in order to reassure the reader that in measuring the consumers' surplus of a new good, or a good the price of which has changed, he should neglect the induced shifts of demand of related goods. (Mishan 1976: 32).

The reduction in the demand for the substitute good shifts the demand schedule to the left, producing a decrease in consumers' surplus. According to Mishan, this loss ". . . is not to be regarded as a loss of consumers' surplus . . ." Instead, "This reduction in area is simply by

the consequence of consumers bettering themselves by switching from good Y to the new lower priced good X." (Mishan 1976:34.)

When Mishan considers relatively close substitutes, he uses a demand schedule for each good and asserts that the area under the demand schedule for the substitute good can be ignored. He defends his position by example and illustration, but changes the case so that the two goods are perfect substitutes. Because what was two goods is now only one good, an aggregate demand schedule replaces two separate schedules. Specifically, Mishan considers the demand for transportation across a certain body where a ferry service is being replaced by a bridge. With the ferry service, the price is P_0 and consumers' surplus is area P_0ab in Figure 2. After the bridge is constructed, the ferry is discontinued and the price of transportation falls to P_1. According to Mishan, the appropriate measure of the benefits of constructing the bridge is the area under the demand curve and between the new and initial price (P_1P_0bc).

When measuring the increment to benefits, it is possible to think of consumers' surplus foregone as being subtracted from the gross increase. With the ferry service, consumers' surplus was area P_0ab. After the ferry is discontinued, consumers' surplus resulting from the bridge is P_1ac.

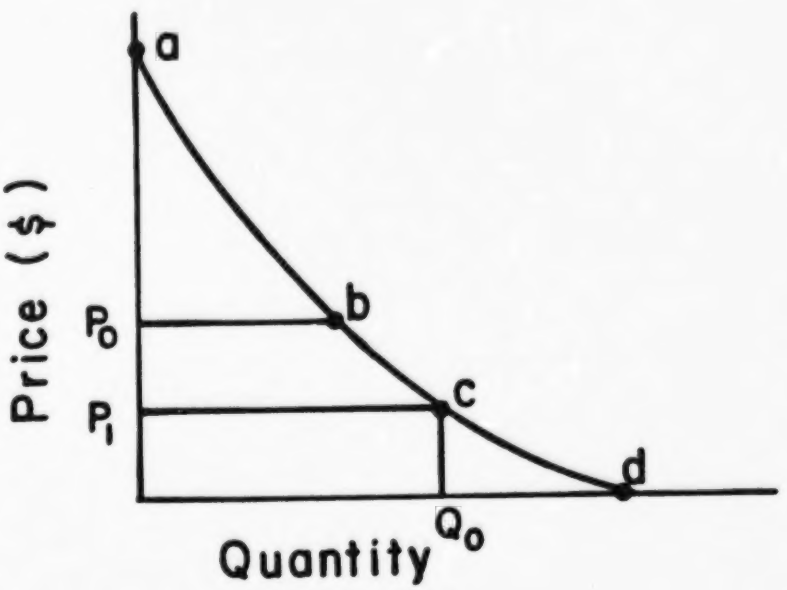

FIGURE 2

CONSUMERS' SURPLUS: THE CASE OF PERFECT SUBSTITUTES

The increment in consumers' surplus is total surplus after the ferry service (P_1ac) minus consumers' surplus foregone from the bridge (P_0ab), and this increment is P_1P_0bc. The reason for subtracting consumers' surplus foregone is that the ferry service is discontinued and the bridge demand schedule assumes that the ferry is not in operation.

Assuming that the ferry could operate if the price were P_0, the demand schedule for the bridge is dcb as before, but it becomes horizontal at price P_0. The amount of consumers' surplus is the same as above, but it is the area above price P_1 and below the bridge demand schedule. No consumers' surplus is subtracted because no consumers' surplus is foregone.

Mishan's position is that benefits of a new site (in this case, a bridge) can be measured by neglecting shifts in the demand for substitutes. However, his justification is an illustration that, in principle, is identical to Knetsch's. By considering the case of perfect substitutes and a single demand curve, Mishan provides no support for the position that the markets for substitutes can be ignored when measuring benefits at a new or improved site. In Mishan's case, like Knetsch's, there is no redistribution in consumers' surplus.

C. Freeman

The analyses of Mishan and Knetsch are special cases and not useful in analyzing the general case in which the site demand curve shifts to the right and the demand for substitutes shifts to the left. Freeman (1979) has explicitly addressed the issue of measuring recreation benefits when the demand curve for substitute sites shifts, so his analysis is reviewed. In Figure 3, the initial demand curve for sites A and B are denoted as D_{A1} and D_{B1}. An improvement in water quality at site A shifts the demand curve outward to D_{A3} (the dashed line), and the demand for the substitute shifts inward to D_{B1}. Benefits of the improvement are measured as the area between the new and initial demand curves for site A and above the market price (area BDGE). According to Freeman, no consideration should be given to the decrease in willingness to pay for the substitute site, area RSVU. He states:

> In utilizing this measure of benefits, there is no need to take into account changes in recreation use at other sites or savings in travel cost (Knetsch 1977). These are captured by the BECD [BDGE in Figure 3] benefit measure. (Freeman 1979:199.)

Freeman's conclusion is that benefits can be measured by demand curve shifts at the improved site and that demand shifts at substitute sites do not explicitly enter into the benefit calculation. Freeman provides no justification for neglecting the decrease in consumer surplus at substitute sites, except for his reference to Knetsch. My review of Knetsch's po-

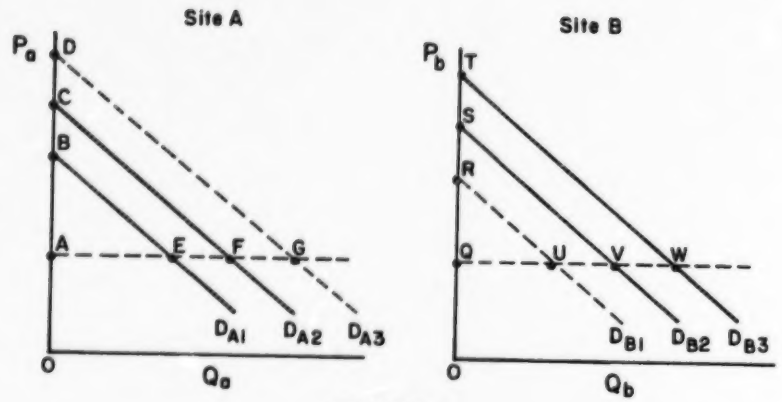

FIGURE 3

DEMAND FOR TWO RECREATION SITES

sition revealed it to be a special case in which there is no decrease in willingness to pay for the substitute site.

D. Support for the Conventional Measure of Benefits

The validity of Freeman's position is not an issue at this point; rather, I contend that the recreation benefits literature (as exemplified by Knetsch, Mishan, and Freeman) does not contain persuasive theoretical justification for the position that displaced benefits should be ignored when calculating net benefits of a new or improved site. Although Mishan, Knetsch, and Freeman reach the same conclusion, they offer no evidence that shifts in the demand for substitutes should be ignored when calculating benefits of a new or improved site. Yet their position seems to be the accepted view of recreation researchers. For instance, Cesario and Knetsch state:

> That is, the value of measurement for a new site is measured independently of any diminutive effects on the use of existing sites. Any losses in consumer surplus at existing sites are irrelevant to the calculation (even though it may be informative for planning purposes to calculate the magnitude of these quantities). Such losses merely reflect changed demand characteristics and losses in the value of some fixed assets, and should have no bearing on the benefit calculation for the proposed site which would be judged on its merits alone (McKean 1958; Mishan 1971; Knetsch 1974). (Cesario and Knetsch 1976:101.)

Cesario and Knetsch provide no rigorous justification for this position, relying instead on references such as Mishan (1971) and Knetsch (1974). The above review of Knetsch and Mishan argues that they do not support the view that any losses of consumer surplus at existing sites are irrelevant.

Although the sample of recreation benefits literature reviewed here is small, the work is probably the most important in this area. On the basis of this review, two general conclusions are suggested. First, the prevailing view is that benefits of a new or improved site can be measured as the area between the new and initial demand curve and above the market price and further, that demand shifts for substitute sites need not be considered. Second, the theoretical support for this position has not been made explicit in this literature.

In an analysis of the potential benefits of a new ski site at Mineral King, California, Cicchetti, Fisher, and Smith (1976) challenge the commonly held view that benefits can be measured by considering only the impacted site.[2] They specify a simultaneous demand equation model in which the price of each ski site is an argument in each demand curve. They assert that specifying a multisite model allows them to estimate the effects of a change in the price at one site on demand and consumers' surplus at the substitute sites. In an edited version of the Mineral King study, Krutilla and Fisher (1975:198) state that the new Mineral King site would result in a reduction in demand for substitute sites and these effects are captured by measuring the change in consumers' surplus over multiple sites. Bishop and Cicchetti (1972) further explain the benefit measure used in the Mineral King paper:

> In a recent paper Cicchetti, Fisher and Smith (1972) simultaneously estimate the demand for various skiing sites in California. The location of other sites and therefore their relative prices are taken into account explicitly by using a generalized least squares regression approach. The benefits of new sites at various locations can be determined by simultaneously estimating the change in consumer surplus for the alternative sites. (Bishop and Cicchetti 1972.)

The estimate of consumers' surplus in the Mineral King study explicitly reflects the reduction in willingness to pay for substitutes. This position is in marked contrast to that taken in the studies discussed above and implies the need to define the theoretical underpinnings of the prevailing view.

[2] Burt and Brewer (1971) used a multi-equation model very similar to that of Cicchetti et al., 1976.

III. Theoretical Underpinning for the Conventional Measure of Recreational Benefits

The above review of the definition of recreation benefits suggests some ambiguity on the issue and the absence of sound theoretical support for any particular definition. I now demonstrate that benefits are properly measured by considering only the demand curve for the affected site. Furthermore, this demonstration follows from an application of elementary economic principles.

The following analysis may assume an environmental improvement at a recreation site (hence a demand curve shift), a decrease in the price of a site, or the introduction of a new site. On grounds of expositional convenience, I consider the net benefits of introducing a new recreation site. Panel B in Figure 4 depicts an ordinary demand curve (ODC) and a Hicks compensated demand curve (HCDC), where OD depicts the quantity of the new good demanded at price P_1.[3] Net benefits of the new good can be measured as the area under the compensated demand curve and above the market price, area P_1P_0F. This area reflects the change in consumers' surplus, as measured under the ordinary demand curve, is generthe willingness to pay for the new good over and above actual payment. On grounds of empirical necessity and the work by Willig (1976), consumers' surplus, as measured under the ordinary demand curve, is generally considered an acceptable approximation to the area under the compensated demand curve. At issue is whether this area correctly measures the benefits of a new site and what consideration, if any, should be given to benefits from displaced facilities.

The issue whether this area correctly measures benefits of a new site is answered by deriving a demand curve for a new recreation site using indifference curves and price lines. Assume that a utility-maximizing consumer allocates all his income between good X (the new recreational opportunity) and a composite of all other goods, which is termed Hicksian money. Before the recreation opportunity was provided, the consumer purchased only the composite good and did not consume good X. As depicted[4] in Panel A of Figure 4, this initial allocation is defined by Point A, which is the point of tangency between price line P_0 and indifference curve I_0. After the recreation opportunity is provided, P_1 becomes the price of recreating relative to the price index of the composite good and the consumer maximizes utility by moving from point A to point G. The change in welfare, as measured by the compensating variation (CV), is AB after it has been converted to dollar terms by multiplying by the

[3] A decrease in the price of a good increases the quantity demanded because people substitute this good for other goods and because the lower price effectively increases real income. The ordinary demand curve reflects both this substitution and income effect. The compensated demand curve reflects only the substitution effect.

[4] The diagram in Figure 4 was presented by Currie, Murphy, and Schmitz (1971:748).

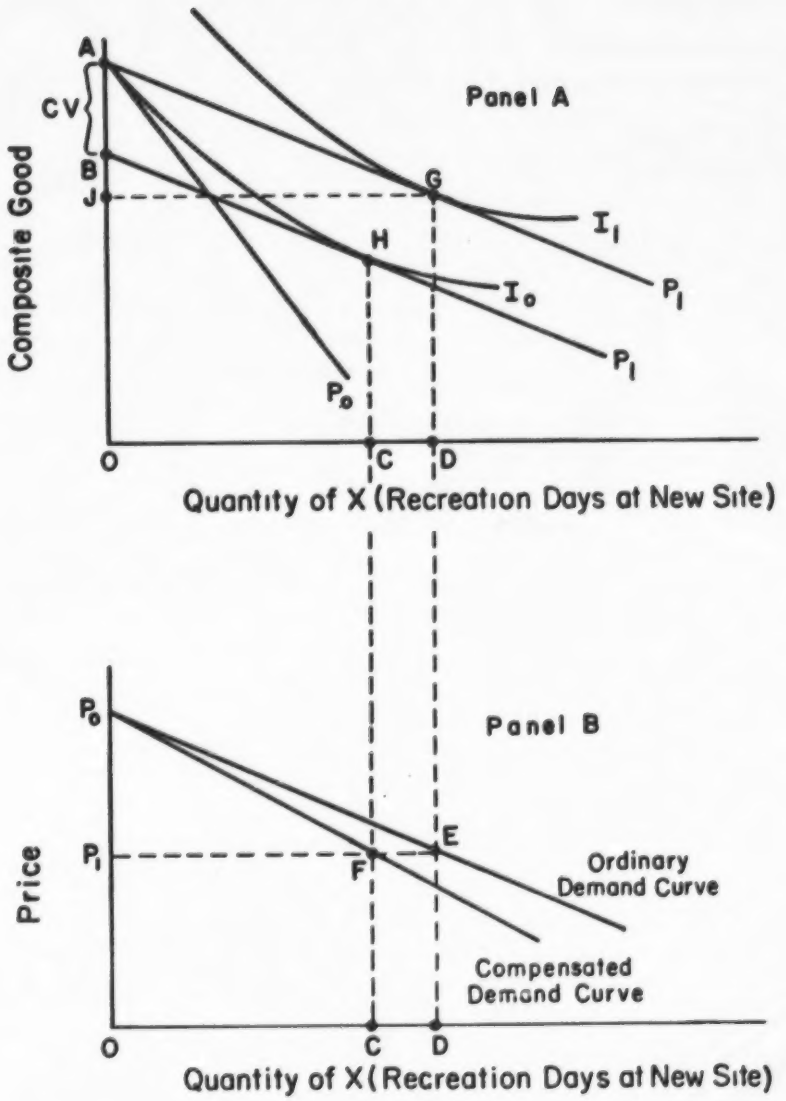

FIGURE 4

CONSUMER'S SURPLUS USING ORDINARY AND COMPENSATED DEMAND CURVES

price index of the composite good. A well known proposition in welfare economics is that this measure of consumer surplus in Panel A corresponds to consumer surplus as measured under the compensated demand curve in Panel B.

The critical point in the analysis is that recreation use at the new site (good X) comes partially at the expense of substitutes, which in this case is the composite good. As a result of the new recreational opportunity, use at the site becomes OD (Panel A) and demand for the substitute decreases by AJ. Hence, the improvement in welfare, which is measured by the movement from indifference curve I_0 to I_1, clearly reflects a reduction in demand for the substitute composite good. The demand curve and consumer surplus in Panel B do not suggest how foregone benefits should be treated. However, the derivation of this demand curve and the corresponding measure of consumer surplus (AB in Panel A) show clearly that measured consumer surplus is a net increment to benefits.

The above conclusion has been derived for the case where a new recreation site is constructed. The conclusion also applies to the case where the quality or price (entrance fee) of a site changes. The case of a price change is depicted in Figure 4 where P_0 is the initial price and P_1 is the new lower price. Recreation benefits which result from a reduced price at the site are measured as AB (compensating variation) in Panel A and as area P_0P_1F in Panel B. These benefits correspond to the benefits which resulted in constructing a new recreation site and changing price P_1.

The above analysis supports the conventional measurement of benefits, subject, however, to a stringent assumption. Returning to Figure 4 Panel A, note that the composite good is an aggregation or weighted sum of all other goods, where the weights are the prices of these goods. As stated originally by Hicks (1939:33), if the relative prices of a group of commodities are given and unchanged, these commodities can be lumped together and treated as a composite good. Hicks' theorem of group commodities is being used to justify defining the decrease in relative price of good X. Specifically, the above conclusion assumes that lowering the price of a new good does not affect the relative price of other goods. If the introduction of a new site affects relative prices of other goods, the composite good theorem is not applicable. At issue then is determining the proper measure of consumer surplus under conditions of multiple price changes.

IV. Consumer Surplus with Multiple Price Changes

The view that recreation benefits can be measured by considering only the market for the single affected site is correct if we assume an ordinary Marshallian partial equilibrium demand curve.[5] In the Marshal-

[5] The Marshallian demand curve is a sufficient but not necessary condition to consider only the affected site. If all other prices change proportionately, the composite good theorem still holds.

lian demand curve, prices of all other goods are fixed, and therefore Hicks' theorem of composite goods is applicable.[6] In this section, we consider the measure of recreation benefits when a new or improved site affects prices in more than one market.

Although the recreation literature gives little attention to this issue, it has been treated at length in the welfare theory literature by Harberber (1971) and Mohring (1971) among others. Borrowing an illustration from Mohring, assume two goods, margarine and butter, whose demand functions can be written as:

$$Q_m = f_1(P_m, P_b, Y)$$
$$Q_b = f_2(P_m, P_b, Y),$$

where the price of margarine (P_m) and the price of butter (P_b) enter into each demand equation along with income (Y). Initial equilibrium in the margarine and butter markets are defined in Figure 5 by points A and C, respectively. The margarine market is analogous to our proposed site, except that Mohring's initial change is a reduction in price. The price of margarine falls from P'_m to P''_m, which produces a decrease in the demand for butter from P_b to P'_b. If the price of butter remains constant at P'_b, consumer surplus is measured as the area under the margarine demand schedule between the new and initial price.

Mohring emphasizes that even though the butter demand schedule shifts, this fact need not be considered when measuring the increase in benefits caused by lower-priced margarine. This point corresponds to our conclusion in the previous section that benefits are correctly measured under the demand curve for the affected recreation site, and displaced facilities can be ignored.

Suppose the illustration is changed so that a decrease in the price of margarine decreases the demand for butter as before, but now the price of butter falls from P'_b to P''_b. This price decrease in butter increases the net willingness to pay for butter and the increment in consumer surplus must be added to the increase in consumer surplus for margarine to obtain the appropriate measure of welfare change. This point is well recognized in the welfare economics literature and can be generalized to state that the change in consumer surplus as a result of price changes in several markets is the sum of the increment of consumer surplus in each market (Harberger 1971).

Mohring emphasizes the ambiguity of measuring the change in consumer surplus in the butter market, and he notes that three measures have been proposed. Using the initial butter demand curve, consumers' surplus is $P''_bP'_bCD$, but this measure is $P''_bP'_bFE$ if the new demand schedule is used. If we move from the initial to the new demand schedule, the change in consumers' surplus is $P'_bCEP''_b$. Because a rationale can be

[6] Freeman (1979, p. 35) and Mishan (1976, p. 32) recognize the necessity of invoking Hicks' composite good theorem when analyzing benefits in a single market.

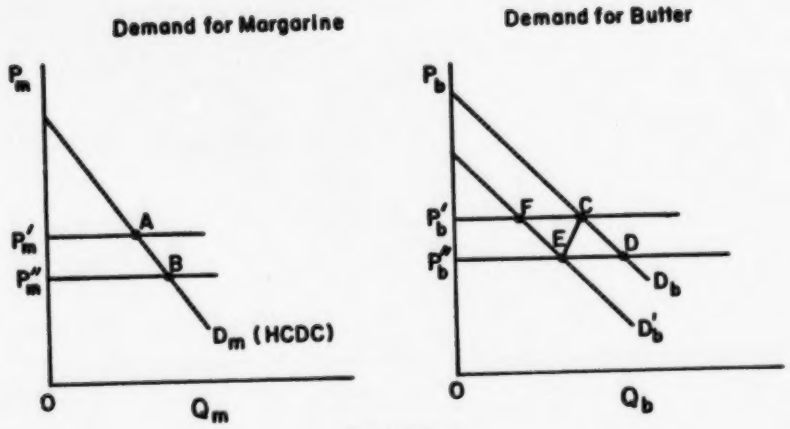

FIGURE 5

MEASURING BENEFITS WITH MULTIPLE PRICE CHANGES

presented for each of these definitions, the measurement of consumer surplus is, in general, sensitive to the definition chosen. This point is recognized in the welfare theory literature and has led Silberberg (1972) to conclude that the appropriate change in utility or welfare cannot be defined unambiguously. Hotelling (1928) noted this indeterminancy in the measure of benefits and also the condition under which consumer surplus could be measured unambiguously. This condition is known as the integrability condition and means that the demand curves have identical cross partial derivatives with respect to prices. The integrability condition for the margarine and butter demand curves is:

$$\frac{\partial Q_b}{\partial P_m} = \frac{\partial Q_m}{\partial P_b},$$

which says that the change in the quantity of butter (Q_b) demanded as a result of a change in the price of margarine equals the change in the quantity of margarine (Q_m) demanded as a result of a change in the price of butter. As noted by Mohring (1971:356), this condition holds if the demand curves are Hicks income-compensated or if the income elasticity of demand for both goods is zero. Burt and Brewer (1971) and Cicchetti et al. (1976) recognized this requirement and, therefore, specified their demand equations as linear and symmetrical.

These conclusions can be restated in terms of our main concern of valuing a recreational site that has a substitute site. Let the price of recreating be defined as the entrance fee or as travel costs. If a decrease in the price of a recreation site (or the construction of a new site) affects the demand for substitutes or complements but leaves their prices (entrance

fee or travel costs) unchanged, benefits are estimated properly as the area under the site demand curve and between the initial and new price. No explicit consideration should be given to the decrease in willingness to pay for the substitute site. Alternately, if the decrease in the price of a site causes a change in relative prices of other goods, such as a substitute site, the increment (decrement) in consumer surplus in the substitute site caused by the price change must be added (subtracted) to that of the first site to obtain the total change in consumer surplus.

A peculiar feature of outdoor recreation is that the price of recreating as measured by entrance fees is generally zero. Where entrance fees are charged (for example, campgrounds), these prices are insensitive to the introduction or improvement in substitute sites. Where travel costs are used as a proxy for price, the travel cost to substitute sites is invariant to a demand shift at the site being analyzed. Therefore, for most all practical applications in recreation, including travel cost analyses, benefits of a new or improved site can be measured correctly as consumer surplus at the new or improved site.

IV. Summary

This paper addresses the issue of the proper measure of benefits at a new recreation site when demand for that site comes partially at the expense of substitute sites. The literature reviewed indicates that some researchers have avoided the issue; others have explicitly subtracted benefits foregone. The prevalent view is that benefits can be measured by considering only the new site demand curve. The limitation with this view is the absence of any theoretical justification. I show that benefits are measured correctly by considering only the demand curve for the new site. The conventional micro-economic model of consumer behavior is used to demonstrate that recreation benefits, measured as willingness to pay for the new site, automatically net out benefits foregone from substitute sites. In the special case in which the introduction of a new site causes prices of other sites or goods to change, the increment in benefits is the net sum of consumer surplus in these affected markets.

References

Bishop, J. and Cicchetti, C. 1972. Some institutional and conceptual thoughts on the measurement of indirect and intangible benefits and costs. In H. M. Peskin and E. P. Seskin (eds.). *Cost Benefit Analysis and Water Pollution Policy*. Washington D.C.: The Urban Institute.

Burt, O. R. 1969. Comments on 'recreation benefits from water pollution control' by Joe B. Stevens, August 1969. *Water Resources Research* 5(4):905-907.

Burt, O. R. and Brewer, D. 1971. Evaluation of net social benefits from outdoor recreation. *Econometrica* 39:813-827.

Cesario, F. J. and Knetsch, J. L. 1976. A recreation site demand and benefit estimating model. *Regional Studies* 10(1):97-104.

Cicchetti, C. J., Fisher, A. C., and Smith, V. K. 1976. An econometric evaluation of generalized consumer surplus measure: the Mineral King controversy. *Econometrica* 44:1259–1276.

Currie, J. M., Murphy, J. A., and Schmitz, A. 1971. The concept of economic surplus and its use in economic analysis. *The Economic Journal* 81(324):741–799.

Freeman, A. M. 1979. *The benefits of environmental improvement: theory and practice.* Baltimore: Johns Hopkins University Press.

Gordon, I. M. and Knetsch, J. L. 1979. Consumers' surplus measures and the evaluation of resources. *Land Economics* 55(1):1–10.

Harberger, A. C. 1971. Three basic postulates for applied welfare economics: an interpretive essay. *Journal of Economic Literature* IX(3):785–797.

Hicks, J. R. 1939. *Value and capital.* Second Edition, Oxford University Press.

Hotelling, H. 1928. The general welfare in relation to problems of taxation and of railway and utility rates. *Econometrica* 16:242–269. Reprinted in K. Arrow and T. Scitovsky, 1969. *Readings in Welfare Economics.* Homewood, Illinois: Irwin.

Knetsch, J. L. 1977. Displaced facilities and benefit calculations. *Land Economics* 53(1):123–129.

Krutilla, J. V. and Fisher, A. C. 1975. *The economics of natural environments.* Baltimore: The Johns Hopkins University Press.

Mishan, E. J. 1976. *Cost-benefit analysis.* New York: Praeger.

Mohring, H. 1971. Alternative welfare gain and loss measures. *Western Economic Journal* 9(4):349–368.

Reiling, S. D., Gibbs, K. C., and Stoevener, H. H. 1973. *Economic benefits from an improvement in water quality.* Washington, D.C.: Environmental Protection Agency.

Silberberg, E. 1972. Quality and the many consumer's surpluses. *American Economic Review* 62(5):942–952.

Stevens, J. B. 1966. Recreation benefits from water pollution control. *Water Resources Research* 2(3):167–182.

Stevens, J. B. 1967. Recreation benefits from water pollution control: a further note on benefit evaluation. *Water Resources Research* 3(1):63–64.

Willig, R. D. 1976. Consumers' surplus without apology. *American Economic Review* 66(4):589–597.